law firm's affairs, election to a seat on the Permanent Court of International Justice (1930–35), receipt of the Nobel Peace Prize (in 1930, for the year 1929) for his labors on behalf of the anti-war treaty, the acceptance of various honors, and the celebration in 1936 of fifty years of marriage rounded out his career. He died at St. Paul of pneumonia following a cerebral thrombosis and was buried in the National Cathedral in Washington, D. C.

On the whole, Kellogg was a reasonably capable but undistinguished Secretary of State. He entered office with no well-thought-out policies, met emergencies not too efficiently as they arose, and generally followed previously developed lines under the counsel of his professional advisers, although he was occasionally checked by Coolidge and sometimes exhibited a stubborn insistence of his own against the convictions of his subordinates. He was generally conservative, an irascible but still a friendly colleague and chief, not prone to long flights of fancy or of leadership—a fitting associate of Calvin Coolidge and an apt exponent of American policies of the 1920's.

[Kellogg's papers are in the Minn. Hist. Soc., which also has the papers of the law firm of Davis, Kellogg, and Severence. The dispatches covering Kellogg's career as Secretary of State are now available in the Nat. Archives (see esp. Record Group 84). The papers of Chandler P. Anderson, Nelson T. Johnson, and William E. Borah, all in the Lib. of Cong., contain valuable material, as do those of Joseph C. Grew, at Harvard Univ.; Henry L. Stimson, at Yale Univ.; and Dwight W. Morrow, at Amherst Coll. The diary of William R. Castle (in private hands), who as an Assistant Secretary of State and Washington neighbor was very close to Kellogg, sheds much light on his personality and working habits. The standard printed work is David Bryn-Jones, *Frank B. Kellogg: A Biog.* (1937); very useful also is Robert H. Ferrell, *Peace in Their Time: The Origins of the Kellogg Briand Pact* (1952). Other sources for particular facts include: Timothy Hopkins, *The Kelloggs in the Old World and the New*, vol. II (1903); *N. Y. Times*, Dec. 22, 28, 1937; biog. references compiled by Dale M. Bentz, Univ. of Ill. Lib. School.]

L. Ethan Ellis

KENNELLY, ARTHUR EDWIN (Dec. 17, 1861–June 18, 1939), electrical engineer, was born at Colaba, near Bombay, India, the younger of two children and only son of David Joseph and Kathrine (Heycock) Kennelly. His father, a native of Cork, Ireland, had spent some time at sea, including service as a captain in the navy of the Royal East India Company; at the time of his son's birth he was harbor-master at Bombay. He later became a barrister in England and King's Counsel in the Province of Nova Scotia, Canada. Kennelly's mother, a native of Leeds, had lived for some time in Bombay, where her father had built one of India's first cotton mills. She died only a few years after her son's birth. The elder Kennelly subsequently remarried twice and had ten additional children. Meanwhile young Arthur had been sent to England for his upbringing. He was educated in private schools in France, Belgium, Scotland, and England, in particular the University College School in London.

Kennelly's interest in electricity was first stirred at the age of twelve when he heard a public lecture by the engineer Latimer Clark on "Submarine Telegraphy." He soon decided to enter telegraph engineering, which with electroplating was one of the two industrial applications of electricity at that time, and next year he left school to become office boy and assistant secretary in the London office of the Society of Telegraph Engineers (later the Institution of Electrical Engineers). Having assiduously studied electrophysics in his spare time, he was in 1876 appointed a telegraph operator in the Eastern Telegraph Company, which operated a network of submarine telegraph cables linking England with Europe and the Orient. For the next ten years he was engaged in submarine cable work in the company's employ.

In 1887 Kennelly came to the United States to join Thomas A. Edison [*q.v.*] in his electrical laboratory at West Orange, N. J. He remained as Edison's principal electrical assistant until 1894. Meanwhile, in 1893, he had become consulting electrician to the Edison General Electric Company and the General Electric Company of New York; and in 1894 he and Edwin J. Houston [*q.v.*] formed the firm of Houston and Kennelly, consulting engineers, in Philadelphia. In 1902 Kennelly was engineer in charge of laying a submarine cable for the Mexican government from Vera Cruz to Campeche. Thereafter his career was devoted to teaching and scientific writing. Appointed professor of engineering at Harvard University in 1902, he taught there until his retirement in 1930. From 1913 to 1924 he was also professor of electrical communications at the Massachusetts Institute of Technology, and for many years he directed the Institute's electrical engineering research.

Kennelly made important contributions to electrical engineering both as an originator and as an interpreter, but it was as an interpreter that he performed his most far-reaching service. In the words of Vannevar Bush: "His carefully chosen nomenclature, his crystal clear exposition, his meticulous mathematical presentations, led thousands to employ powerful methods of

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analysis which would otherwise have remained abstruse and hence available only to a few. It is not too much to say that he changed the whole course of the methods of the electrical engineer. . . ."

This was particularly true of his contributions in the field of circuit theory. The mathematical analysis of direct-current circuits was a simple matter, making use of scalar quantities; but with alternating currents it was necessary to include phase as well as magnitude. Mathematicians had long dealt with the so-called imaginary and complex variables, and these had been applied to certain differential equations in physics. In his important paper "Impedance" (*Transactions of the American Institute of Electrical Engineers*, vol. X, 1893) Kennelly crystallized the application of these variables to alternating currents. Almost immediately complex numbers began to be used widely and freely by electrical engineers in the analysis of alternating-current phenomena.

Again, the English physicist and electrician Oliver Heaviside had in 1891 given in terms of hyperbolic functions the fundamental steady-state equations for potential and current along a line, but under alternating-current conditions he showed only lengthy scalar methods for their solution. In 1894 Kennelly gave the first solution in terms of complex hyperbolic functions and at the same time introduced polar notation for complex quantities. He later expanded the use of complex hyperbolic quantities to lines (for example, by converting the "nominal" π or T of a smooth line into an "equivalent" π or T). His publications, including tables of complex hyperbolic functions and charts, have been used extensively, both by students and by practising engineers, for the solution of line problems. The use of complex numbers and the application of complex hyperbolic functions to lines were two of Kennelly's most important contributions to the art of electrical engineering and undoubtedly advanced its development many years.

In a different area, Kennelly noted that the transatlantic radio waves sent from England by Marconi in 1901 and received in Nova Scotia were far stronger than could be explained by simple three-dimensional wave expansion, particularly when the curvature of the earth was taken into consideration. He advanced the theory, in March 1902, that the conducting properties of the ionized rarefied upper atmosphere reflected the electromagnetic waves, an explanation also propounded independently later that year by Heaviside. This theory has since been verified experimentally, and the ionized layer has become known as the Kennelly-Heaviside layer. In another important discovery, in 1912, Kennelly worked out jointly with G. W. Pierce the motional impedance circle for a telephone receiver. This made it possible to evaluate the performance of telephone receivers as well as of other apparatus having a vibrating electromechanical system.

Always deeply interested in electrical units and standards, Kennelly was secretary of the standards committee of the American Institute of Electrical Engineers at its inception and later became its chairman. Likewise, at its inception in 1908 he was secretary, and later president, of the United States National Committee of the International Electrotechnical Commission (IEC). He represented the United States at the Paris congress and other European meetings and played an important role in the compilation of the IEC "Vocabulary" (1938) of electrical definitions. On several occasions he was a delegate to international conferences on units and standards and assisted materially in the development of the Meter-Kilogram-Second (MKS) system of electrical units, which was later standardized internationally. Similarly, as president of the American Metric Society and an officer of the Metric Association he worked arduously to effect the adoption of that system in the United States.

Widely honored, both at home and abroad, Kennelly was president of the American Institute of Electrical Engineers (for two terms, 1898–1900), of the Illuminating Engineering Society (1911), and of the Institute of Radio Engineers (1916). In 1935 he was chosen honorary president of the Union Radio Scientifique Internationale. He received honorary degrees from the University of Pittsburgh, Harvard, the University of Toulouse in France, and the Technische Hochschule of Darmstadt, Germany. He was awarded a variety of medals, among them the Edward Longstreth and Howard Potts medals of the Franklin Institute and the Edison Medal of the American Institute of Electrical Engineers, and was elected to membership in the National Academy of Sciences (United States) and the Royal Swedish Academy of Sciences. His publications include twenty-eight books (ten as sole author, eighteen as co-author) and over 350 technical papers.

The same gifts of clarity and precision of expression that were evident throughout Kennelly's work made him a remarkable teacher. Genial and ready of wit, he had a wide range of interests and was versatile and resourceful.

On July 22, 1903, he married Dr. Julia Grice of Philadelphia, a graduate of the Woman's Medical College of Pennsylvania who was practising medicine in Boston. They had two children, a daughter, Isabella, who died in infancy, and a son, Reginald Grice. Kennelly died of uremic poisoning in Boston at the age of seventy-seven. His ashes were scattered in Mt. Auburn Cemetery, Cambridge, Mass.

[*Electrical Engineering*, Aug. 1939; Chester L. Dawes in *Science*, Oct. 6, 1939; memoir by Vannevar Bush in *Nat. Acad. Sci. Biog. Memoirs*, vol. XXII (1943), with comprehensive bibliog. of his pubs.; *Am. Philosophical Soc. Year Book*, 1939; *Trans. Illuminating Engineering Soc.*, July 1939; private papers of Kennelly; family information from Kennelly's son, Grice Kennelly.]

CHESTER L. DAWES

KERBY, WILLIAM JOSEPH (Feb. 20, 1870–July 27, 1936), Roman Catholic clergyman, sociologist, was born at Lawler, Iowa, the third son and fifth child in a family of ten. His parents, Daniel Riordan and Ellen (Rochford) Kerby, were devout Irish immigrants. His father, a successful small-town banker, had been well trained in the classics and early taught his son Latin and Greek. After attending the local public school, young Kerby received his high school and college education at St. Joseph's College (later Loras College) in Dubuque, Iowa, graduating in 1889. He trained for the priesthood at St. Francis Seminary, Milwaukee, and was ordained at Dubuque on Dec. 21, 1892. During the academic year 1893–94 he studied at the Catholic University of America in Washington, D. C., where Thomas Joseph Bouquillon [*q.v.*] interested him in the study of the influences of late-nineteenth-century European social movements on the United States. He continued his social studies at the universities of Berlin, Bonn, and Louvain during the years 1895–97, receiving his doctorate from Louvain in 1897 with a dissertation on American socialism. In the autumn of 1897 he began his teaching career as associate professor of sociology at the Catholic University of America. He subsequently became professor in 1906, a post he held until his death.

Upon his return to the United States, Kerby found the Catholic Church in the United States in a turmoil over the issue of "Americanism": *i.e.*, what concessions should the Church make to its new environment in order to fulfill its mission? The liberal clergy, led by Archbishops John Ireland of St. Paul, Minn., and John J. Keane, former rector of Catholic University of America [*qq.v.*], advocated the development of an American Catholicism adjusted to the republican, pluralistic environment of the United States. They were opposed by many of the conservative German and eastern clerics, led by Archbishops Michael Heiss of Milwaukee and Michael A. Corrigan of New York [*qq.v.*], who argued that the liberals would compromise Catholicism out of existence in the prevalent Protestant atmosphere of the United States. The open controversy was concluded in January 1899 by papal condemnation in Pope Leo XIII's letter *Testem benevolentiae* of the liberal or "Americanist" position. The issue, however, remained central for any Catholic cleric interested in social reform, if only because such work involved close cooperation with non-Catholics. Kerby, whose mentor Bouquillon had been vigorously attacked by the conservatives, took care to avoid any suspicion that his teaching contained opinions condemned in the papal letter. He maintained privately, however, that "the most fault is on the conservative side because it identifies liberalism with heresy" (Barry, *post*, Appendix, p. 325).

Leo XIII's encyclical *Rerum novarum* (1891) had offered a broad charter for social reform, and it was this encyclical that Kerby stressed in the course of lectures on the American labor movement which he gave for several summers, beginning in 1898. Throughout his teaching and writing Kerby continued to defend labor organization, but he soon turned his major reform efforts to the field of Catholic charitable work. His first aim was the consolidation of local units into a central organization in order to eliminate needless duplication of effort. Using as a springboard his intimacy with the Society of St. Vincent de Paul, whose *Quarterly* served as the information bulletin for the various charities, Kerby, in association with his faculty colleague Charles P. Neill, persuaded all the bishops to permit Catholic societies to participate in an exhibit of charitable organizations at the St. Louis World's Fair of 1904. The public's favorable reception encouraged him to carry forward his efforts at consolidation; these efforts reached ultimate success with the organization of the National Conference of Catholic Charities in September 1910. For the next ten years Kerby served as the Conference's secretary. His indefatigable work moved one bishop to observe in 1918: "I repeat the same old story when I say that the Conference is practically Dr. Kerby." Meanwhile he lent his interested support to the founding of the National Catholic War Council (1917) and to its subsequent work.

In 1916 Kerby began publication of the